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TAMPING CONSTRUCTION MACHINE

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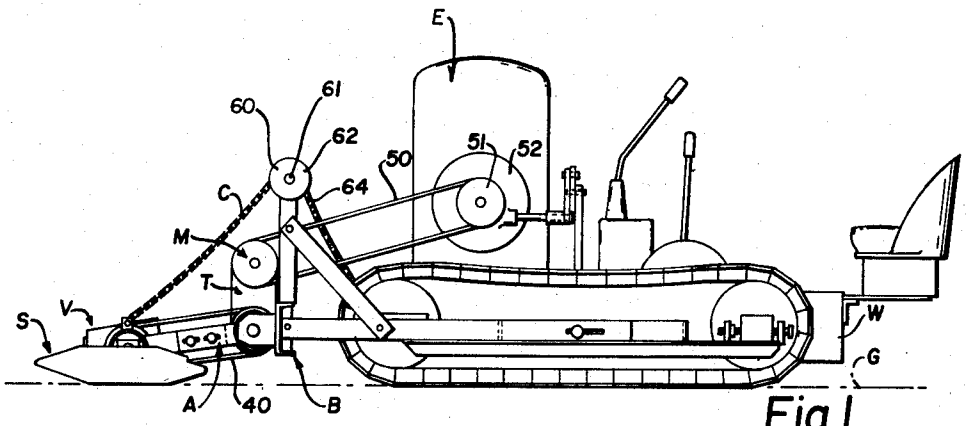

Fig.1

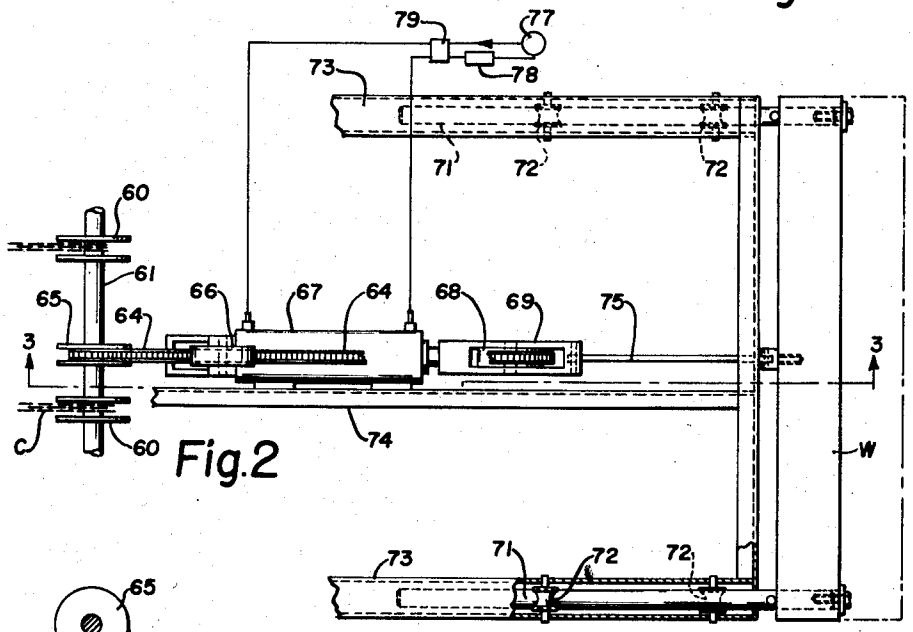

Fig.2

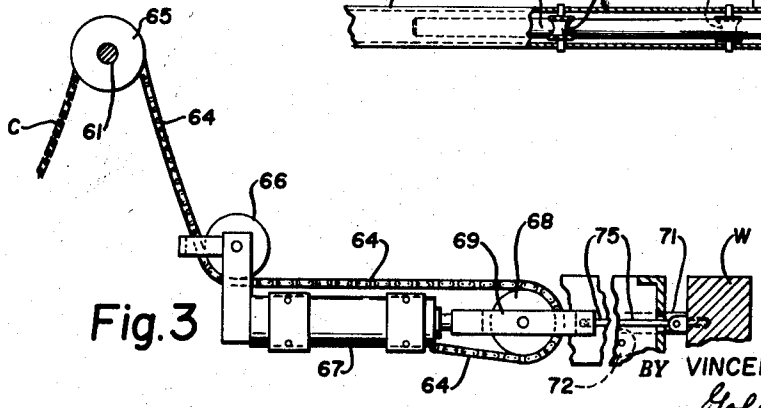

Fig.3

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TAMPING CONSTRUCTION MACHINE

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The present invention relates to a tamping apparatus for road and like construction, used in tamping and compacting earths, gravel or coarse aggregate and other laid materials; and more particularly to an improved mechanism for raising and lowering tamping elements carried on a vehicle comprising part of such apparatus.

Construction apparatus of a vibratory compacting or tamping type is frequently used in the construction of roads, air strips and other like extensive generally flat areas, at times to compact loose earth, but more usually to compact coarse aggregate or gravel spread in a loose layer over the construction area and further to settle finer particulate or granular material, spread over the top of a previously laid structure of coarse material, into and fill voids in such coarse material and to compact the resultant filled layer to a desired density. Such apparatus comprises a suitable vehicle, generally of crawler or caterpillar tractor type carrying a transversely disposed series of individually actuated tamping elements or shoes arrayed across the front of the vehicle to slide over and compact the vehicle supporting surface, the ground or other material being compacted, as the vehicle traverses the same.

Since the apparatus functions as a vehicle not only in compacting traverse of an area under construction, but also in merely moving the apparatus from one place to another without compacting operation, it is desirable not only that vehicular movement be had without shoe operation but also that the shoes may be lifted safely clear of the ground contact for relatively fast movement of the apparatus. When for such purpose the relatively heavy array of shoes is lifted from the ground, the weight of the same is assumed by the forepart of the vehicle, thereby tilting the vehicle forward and causing front heaviness which is undesirable when fast safe vehicular movement is required. Further, such increase and shift in weight on the crawler treads toward the front of the vehicle often will cause indentation of an already finished leveled compacted area perchance beneath the apparatus or of soft ground with increased possibility of the vehicle becoming enmired.

The apparatus of this invention includes a mechanism for lifting the entire array of shoes out of, and returning the same to, operative ground contacting position and a counterweight extensible out from the end of the vehicle opposite the shoe array as the lifted shoe array weight is assumed by the vehicle, whereby the vehicle is stabilized for safe fast noncompacting travel as the shoe array is lifted out of contact with the ground. Such mechanism also provides for extending the counterweight at least partially somewhat in advance of the beginning of actual lifting of the shoe array to avoid indentation of compacted material or of soft ground.

In the drawings:

Fig. 1 is a side view of a road working machine embodying this invention;

Fig. 2 is a plan view of a shoe lifting and counterweight shifting mechanism isolated from the vehicle; and

Fig. 3 is a side elevational view corresponding generally to Fig. 2.

In the drawings, Fig. 1, there appears a crawler or caterpillar tractor type vehicle driven and controlled in vehicular movement, through any suitable power transmission to the crawler treads, by an engine E. The engine E also provides power for vibrating, raising and lowering a plurality of similar tamping shoes S mounted in transverse array across the front of the vehicle. Each material tamping or compacting shoe S is mounted through a pair of parallel adjustable length arm structures A pivoted on a beam member B extending transversely across the front of the vehicle, whereby the shoe may be swung, from its normal operating position in sliding contact with the top of the ground or other material to be compacted (indicated by dashed horizontal line G), upwardly and rearwardly by retracting force applied through a pair of chains C each anchored on the lower end of a respective arm. A counterweight W is mounted at the rear of the vehicle, to be extended rearwardly when the shoe array is lifted from and retracted when the shoe array is lowered to operating position in contact with the ground, by mechanism hereinafter described.

In each shoe a vertical vibratory compacting motion is developed by a suitable individual mechanical vibrating unit V driven commonly with the other shoes by engine E through mechanism including a corresponding vertically extended transmission unit T secured on beam B, and intermediate input shaft means M connected between the units T of the several shoes. Coplanar V-belt pulleys or sheaves, as the output of unit T and input of vibrator V, are drivingly connected by the belt means **40**. The output pulley is coaxially aligned with the upper arm pivots on member B; and the mechanical connection of the shoe to the lower end of the arm and positioning of the vibrator input sheave is such that the axis of the latter retains a substantially constant radial distance from the output pulley. Thus oscillatory vertical movement of the shoe during compacting operation is ineffective to vary belt length or tension, and the belt is retained in proper disposition during raising and lowering of the shoes.

The vibrating unit V may be comprised of a pair of parallel-shafted, like meshed unbalanced gear wheels, with the shaft of one of the wheels carrying the aforementioned input sheave and with the unbalanced wheels so meshed relative to the annular positioning of their eccentric mass centers that strong vertical forces are developed to vibrate the shoe vertically on the order of 2000 v.p.m. Preferably the plane of the shafts is horizontal in normal disposition on level ground.

Preferably the unit V is rigidly secured centrally of the shoe, and the plan outline of the shoe is rhomboidal so that with say four shoes ganged in side-by-side disposition all the material across the overall span of the set of shoes is compacted during forward advance of the vehicle.

In the case of end shoes of a gang, at least one end, for the other intervening shoes, both ends of the input shaft in the corresponding transmission unit T are connected to the like units of adjacent shoes to form the shaft means M by suitable coupling units and inserted connecting shaft elements. Such couplings for example may be comprised of a pair of sprockets of like teeth and pitch diameter secured on respective aligned shaft elements joined thereby and a circularly joined disjoinable length of sprocket chain with link width sufficient to accommodate the teeth of the two sprockets side by side, thereby to facilitate not only assembly in manufacture but also maintenance of the tamping machine. The input shaft at the top of one transmission unit has a sheave to which plural V-belt means **50** drivingly connects the output pulley **51**, of a power take-off unit **52** on the engine E.

The power take-off unit **52** includes, between the engine

shaft and pulley 51, a clutch provided with suitable controls manipulated by the machine operator for applying or cutting off power to all the shoe actuating units V simultaneously.

For raising and lowering the shoe array, there is arranged a series of aptly spaced sheaves 60 fixed on the elevated transverse shaft means 61 rotatably supported on standards or uprights 62 extending upwardly from the transverse beam B, each chain C being reeved about a corresponding sheave.

In direction opposite the reeving of chains C, a chain 64 (see Figs. 1 and 2) is at one end reeved about a sheave 65 fixed on the midportion of shaft means 61, and passes downwardly to bend around a guide roller or pulley means 66 bracketed on one end of a double acting hydraulic piston-cylinder unit 67 centrally mounted in the vehicle frame. Thence chain 64 runs generally parallel to the cylinder to pass around a similar guide roller or pulley 68 rotatably supported in a block 69 secured to the end of the piston rod, the other end of chain 64 being anchored to the cylinder.

Thus with guide roller 66 and one end of chain 64 fixed, and the other end suitably reeved on sheave 65, extension of the piston in hydraulic unit 67 in a motion multiplying connection against chain 64 causes rotation of shaft 61 to wind chains C onto sheaves 60 and thereby lift simultaneously the entire gang of shoes. Retraction of the piston permits the shoes to drop by their own weight into operative ground contacting position, thereby causing chains C to unwind from sheaves 60 turning shaft 61 and sheave 65 to rewind chain 64 onto the latter. By a suitable choice of lengths in the chains C and 64, the weight and vibration of chains C during compacting operation will cause further unwinding of chains C from sheaves 60. This results in slack in chains C further to minimize communication of vibration from the shoes to the vehicle during compacting operation, and further provides a lost motion in the lift mechanism for purposes to be described.

The counterweight W, a heavy mass extending across the rear of the vehicle, has rigid spaced forwardly projecting generally coplanar mounting arm members 71, extending forwardly into the chassis frame and each supported by suitable support and guide rollers 72 secured within say hollow longitudinal chassis frame members 73 or externally of longitudinal frame members, so that the weight may be extended rearwardly from the chassis to increase the lever arm length, hence the effective moment, of the weight and retracted to decrease the same.

Th previously described hydraulic unit 67 with associated elements is secured to the vehicle frame parallel to and about midway between the counterweight arm members 71 as on central longitudinal frame member 74; and the piston rod thereof through block 69 and link 75 is secured to the center portion of the counterweight. Hence extension and contraction of the cylinder unit for raising or lowering the shoes likewise serves to extend or retract the counterweight.

Since the moment of the mass of the shoe array, which would tend to cause front heaviness in the machine, is greatest about the time when the array leaves contact with the ground, thereafter decreasing as the arms swing upward, it is preferable that the actual lifting of the shoes out of ground contact be delayed until the counterweight has been at least partially extended. This is simply done by providing some lost motion in the shoe lifting system. For example by providing for slack in chains C when the shoes are in ground contacting position, in the previously described manner, the counterweight may be extended at least partially before lifting force is applied by chains C to the shoe array. Thereafter with continued extension of the piston, lifting of the shoes ensues, as well as further counterweight extension to a degree required for the desired vehicle travel stability.

Accordingly front heaviness of the entire machine during travel is avoided and stability attained. Also the delayed lifting of the array, until after an initial counterweight extension, prevents the forward ends of the crawler treads from sinking or digging into any underlying soft ground or already finished, compacted level work. The latter result is of two-fold special importance. First, at times the machine may be run off a work area into soft ground before the shoes are lifted, and were the front ends of the treads to sink on shoe lifting, the machine would be the more likely to become mired. Secondly, under certain required compaction practice in road building, the shoe array is lifted frequently while the machine is on leveled compacted finished area. Hence, were provision not made for avoidance of indentation of the finished work upon lifting of the array, the resulting multiplicity of indentations would require not only additional labor in filling and leveling such depressed areas, but also in many instances would represent areas wherein the compaction density varies from specification requirements.

To control the shoe lifting and counterweight shifting means, a suitable hydraulic circuit is used, including a pump 77 driven by the engine E for example, a reservoir tank 78 for hydraulic liquid supply to the pump, a two-position hydraulic control valve 79 adapted to apply fluid from the pump selectively to either end of the double acting hydraulic cylinder 67 while simultaneously putting the other end of the cylinder into communication with the reservoir for exhausting liquid therefrom. Thus setting the control valve to one or the other position moves the shoe array and counterweight to and retains the same at one or the other position. Preferably the control of the shoe lift counterweight mechanism and of the vehicle are interlocked, so that a high speed vehicular traverse may not be obtained unless the shoe array is retracted and accordingly the counterweight extended.

I claim:

1. In a tamping construction apparatus including a vehicle for operative traverse over a construction area to be compacted and tamping shoe means disposed across and liftably supported by one end of the vehicle, the combination comprising: a counterweight for the shoe means horizontally reciprocably mounted on the other end of the vehicle for movement in a direction longitudinal to the vehicle; power operated extensible and retractable means having one element thereof fixed to the vehicle frame and a second element movable with respect to the first named element, said second element being linked to the counterweight for extending and retracting the same; and shoe lifting means reacting on the vehicle for applying a lifting force to the said tamping shoe means to raise the same from an operating ground contacting position to a lifted position for vehicle travel; means interconnecting the said second element of said power operated means to and as actuating means for said shoe lifting means, whereby the counterweight is extended or retracted respectively in the course of raising or lowering of the shoe means.

2. In a tamping construction apparatus including a vehicle for operative traverse over a construction area to be compacted and tamping shoe means disposed across and liftably supported at one end of the vehicle, the combination comprising: a counterweight for the shoe means horizontally reciprocably mounted on the other end of the vehicle for extension endwise from the said other end; a power operated extensible and retractable means having one element thereof fixed to the vehicle frame and a second element movable with respect to the first named element, said second element being linked to the counterweight for extending and retracting the same; and shoe lifting means for applying a lifting force to the said tamping shoe means to raise the same from an operating ground contacting position to a raised position for vehicle travel, including first and second sheave means fixed on a common shaft rotatably

supported on the vehicle chassis above the level of the shoe means, lift chain means connected to the shoe means and reeved on the said first sheave means, actuating chain means reeved in direction opposite the lift chain means on the second sheave means and having an operative connection with said second element of said power operated means, whereby the counterweight is extended or retracted respectively when retraction or lowering of the shoe means is effected.

3. An apparatus as described in claim 2, including arm structures pivoted to the vehicle and carrying said shoe means; and also including length in said chain means providing lost motion between said power operated means and said shoe means, whereby lifting of said shoe means is delayed until at least a partial extension of said counterweight is effected.

4. In a tamping construction apparatus including a vehicle for apparatus traverse over a construction area to be compacted and tamping shoe units disposed in a transverse array across one end of the vehicle and individually pivotally supported thereon by vertically swingable arm means, the combination comprising: a counterweight for the shoe units mounted on the other end of the vehicle for horizontal reciprocation; a double-acting fluid operated piston-cylinder device having a cylinder longitudinally secured to the vehicle and piston linked to the counterweight for extending and retracting the same; transverse shaft means rotatably supported in elevated parallel disposition relative to said array by mounting means fixed to the vehicle chassis; chain means having near one end an operative connection with said piston and the other end reeved about said shaft means; at least one lift chain for each shoe unit having a lower end connected to a corresponding shoe unit and upper end reeved about said shaft means in sense opposite said chain means; and operator controlled means for supplying fluid pressure selectively to opposite ends of said device; whereby the shoe units may be lifted and counterweight extended or shoe units lowered to tamping position and counterweight retracted with the apparatus longitudinally stabilized.

5. In a tamping construction apparatus including a vehicle for apparatus traverse over a construction area to be compacted and tamping shoe units disposed in a transverse array across one end of the vehicle and individually pivotally supported thereon by vertically swingable arm means, the combination comprising: a counterweight for the shoe units mounted on the other end of the vehicle for horizontal reciprocation toward and away from the shoe array; a double-acting fluid operated piston-cylinder device having a cylinder longitudinally secured to the vehicle and piston linked to the counterweight for extending and retracting the same; shoe lifting mechanism including transverse shaft means rotatably supported in elevated parallel disposition relative to said array by mounting means fixed to the vehicle chassis, pulley means secured on said piston, first chain means bearing on said pulley means on the side toward said counterweight, and having one end fixed relative to the vehicle chassis and the other end reeved about said shaft means, second chain means including at least one lift chain for each shoe unit having a lower end connected to a corresponding shoe unit and upper end reeved about said shaft means in sense opposite the first said chain means; and operator controlled means for supplying fluid pressure selectively to opposite ends of said cylinder, whereby the shoe units may be lifted and counterweight extended or shoe units lowered to tamping position and counterweight retracted with the apparatus longitudinally stabilized.

6. An apparatus as described in claim 5, wherein said shoe lifting mechanism provides a lost motion connection ultimately between said piston and shoe units in shoe lifting action by a length in one of said chain means exceeding that required for free tamping oscillation of the shoes when in lowered position, whereby lifting of said shoe units by extension of said piston is delayed until said counterweight has been partially extended.

7. In a tamping construction apparatus including a vehicle for apparatus traverse of a construction area to be compacted and tamping shoe units disposed in a transverse array across one end of the vehicle and individually supported thereon, the combination comprising: individual shoe support means including for each shoe unit a pair of spaced, like parallel arm members each secured at one end to the shoe unit and at the opposite end pivotally secured to the vehicle to swing about a common horizontal pivot axis; a counterweight for the shoe units mounted on the other end of the vehicle for horizontal reciprocation; a double-acting fluid operated piston-cylinder device having a cylinder longitudinally secured to the vehicle and piston linked to the counterweight for extending and retracting the same; transverse shaft means rotatably supported in elevated parallel disposition relative to said array by mounting means fixed to the vehicle chassis; pulley means secured on said piston; chain means bearing on said pulley means on the side toward said counterweight, and having one end fixed relative to the vehicle chassis and the other end reeved about said shaft means; at least one lift chain for each shoe unit having a lower end connected to a corresponding shot unit and upper end reeved about said shaft means in sense opposite said chain means; and operator controlled means for supplying fluid pressure selectively to opposite ends of said cylinder, whereby the shot units may be lifted and counterweight extended or shot units lowered to tamping position and counterweight retracted with the apparatus longitudinally stabilized.

8. A tamping construction apparatus as described in claim 7, wherein said lift chains and chain means exceed in respective lengths the lengths effective in moving the shoe units between extreme operating lowered and raised positions for providing slack in the lift chains with the shoe units at operating position and also a lost motion ultimate connection between the cylinder device and shoe units.

9. In a tamping construction apparatus including a vehicle for apparatus traverse over a construction area to be compacted and tamping shoe units disposed in a transverse array across one end of the vehicle and individually pivotally supported thereon by vertically swingable arm means, the combination comprising: a counterweight for the shoe units mounted on the other end of the vehicle for horizontal reciprocation; a double-acting fluid operated piston-cylinder device having a cylinder longitudinally secured to the vehicle and piston linked to the counterweight for extending and retracting the same; transverse shaft means rotatably supported on the vehicle chassis in parallel disposition relative to said array; chain means having near one end an operative connection with said piston and the other end reeved about said shaft means; at least one lift chain for each shoe unit having one end directed downwardly to a connection with the corresponding shoe unit and its other end reeved about said shaft means in sense opposite said chain means; and operator controlled means for supplying fluid pressure selectively to opposite ends of said device; whereby the shoe units may be raised and counterweight extended or shoe units lowered to tamping position and counterweight retracted with the apparatus longitudinally stabilized.

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